# SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) OPINION BY WRITTEN PROCEDURE

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# Advice on Harvest control rules for the long-term management of Baltic salmon

Response to a request from the European Commission for complementary information to the opinion delivered by the STECF plenary (STECF/PLEN-09-03).

DECEMBER 2009, WRITTEN PROCEDURE

**Edited by John Casey & Hendrik Dörner**

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**OPINION OF THE SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES BY WRITTEN PROCEDURE**

**Advice on Harvest control rules for the long-term management of Baltic salmon**

**Response to a request from the European Commission for complementary information to the opinion delivered by the STECF plenary (STECF/PLEN-09-03) regarding harvest control rules for the long-term management of the Baltic salmon**

**DECEMBER 2009**

## Background and request to STECF

The Commission has recently received the advice from STECF regarding harvest control rules for the long-term management of the Baltic salmon (32nd plenary meeting report of the scientific, technical and economic committee for fisheries (Plen-09-03)). The advice did give the Commission some useful answers; however, it did not provide us with a way forward as we had hoped for. The Commission also does not feel that the advice for a zero catch of salmon is practical and sufficiently took into account the fact that a big share of the stock is reared and should be fished in order not to jeopardise the genetic diversity of the wild river stocks. We would for that reason like to ask reiterate our question to the STECF.

Taking into account:

Occasional strong outbreaks of M74

The post smolt survival of the Baltic stock

The share of reared salmon in the catches

And assuming that weak wild salmon river stocks will to a large extent be protected by Member States national measures and not be caught to any substantial degree in the coastal or river fishery.

The Commission requests STECF to:

Advise on the likely development of the Baltic salmon stock if the harvest control rules would set a constant harvest rate for the sea fishery at:

a) 0.2

b) 0.3

c) 0.4

**STECF response**

Methods

STECF's response in based on a set of simulations undertaken on 7-9 December 2009, by members of the ICES WGBAST; Atso Romakkaniemi and Henni Pulkkinen, Finnish Game and Fisheries Research Institute.

The WGBAST 2009 assessment (ICES. 2009. Report of the Baltic Salmon and Trout Assessment Working Group (WGBAST), 24–31 March 2009, Oulu, Finland. ICES CM 2009/ACOM:05. 280 pp.) was used as the basis of simulations. The only changes made were those necessary to simulate the alternative scenarios formulated in the Commission's request.

It is assumed that the target reference point for the status of wild stocks is a smolt production of 80% of the potential smolt production capacity (PSPC). The milestone years are assumed to be 2015 and 2020 for 'not weak' and 'weak' stocks, respectively. Therefore, probabilities for the individual rivers to reach 80% of their PSPC by 2015 and 2020 were analysed and presented.

In addition to the 80 % target the stock development was analyzed against probability of stock collapse. STECF at the November 2009 plenum defined stock collapse for a salmon stock in the Baltic as the situation where the smolt production is less than 10% of the potential production.

The rivers for which simulations were possible were classified into weak and not weak stocks based on the expected short term (2010-2013) development of the smolt production in comparison with their respective PSPC (WGBAST report 2009, Annex 3, Figures 2a-c). The following stocks were classified as 'weak':

Simojoki (Assessment Unit 1 (AU1))
Rickleån (AU2)
Öreälven (AU2)
Mörrumsån (AU4)
Emån (AU4)

In general AU5-6 (Assessment units of Main Basin, Gulf of Finland) rivers hold the salmon stocks that are in the most critical state. However, the available information for these stocks is insufficient to include any of them in the current assessment model, but included in these AUs are rivers where stock status of salmon is most critical. The Môrrumsåen and Emån stocks although belonging to

AU4 are considered to be the best available representative for the stocks in AU5-6. For this reason the Môrrumsån stock has been classified as 'weak' although it presently could be classified as not weak.

The remaining stocks were classified as 'not weak'.

Scenarios were simulated assuming effort scenario number 4 (i.e. including the whole range of uncertainty) for the fishing years 2009 and 2010, as defined in the Table 5.4.2.1.a (page 169) of the WGBAST 2009 report. The evaluated harvest rates (HRs) was assumed to be implemented by 1. January 2011.

The starting year of the simulated post-smolt mortality rate was 2009.

The base case scenarios follow the assumptions given in the Commission's request. The constant HR scenarios of 0.2, 0.3 and 0.4 were supplemented with zero (no fishing) and 0.1 harvest rate (HR) scenarios for comparisons. Seasonal HR's were fitted so that the cumulative HR of 3-sea-winter (3SW) spawners matches with the given constant HR. For spawners that mature at younger age, the cumulative HR is lower while it is higher for the older spawners (fish that mature at older age). 3SW spawner was chosen as the reference age, because it is closer to the average age of female spawners in the sea. Due to the fact that some rivers of AU1-2 were regarded as 'weak', it was assumed that there is no coastal fishing anywhere in accordance with assumption in the Commission's request ("weak wild salmon river stocks will to a large extent be protected…" etc. see Background above). In practice, some coastal and estuary fishing could take place in some northernmost regions of Bothnian Bay, but the current simulation model is not able to take into account such spatially restructured coastal fishing.

In addition to the base case scenarios, two scenarios in which some coastal fishing was allowed ("min coastal effort" in Table 1) and thus catches of salmon from the 'weak' stocks were also evaluated. The so-called minimum coastal effort scenario of the WGBAST 2009 report was chosen, allowing a coastal HR of about 0.2 for the northernmost (AU1) stocks (Figure 5.4.3.4.a in WGBAST 2009), lower for the more southern Gulf of Bothnia stocks, and zero for the AU4 stocks. This scenario for the coastal fishing is equivalent to the scenario used as the basis of ICES advice for fishing in 2010. Although some coastal fishing is assumed here, we still assumed that there is no river fishing of 'weak' stocks.

Results

Stock specific simulation results for SSB, smolt production estimates, size of the reared stock in terminal areas (related to genetic risk due to unexploited straying salmon), probabilities of reaching the target reference point of a smolt production of 80 % of the potential smolt production and coastal and offshore catches using HR from 0 to 0.4 are given in Figures 1 to 7.

Table 1 includes a summary of the river specific probabilities to reach 10 and 80 % of the smolt capacity for each of the harvest rate scenarios.

In the simulation results, the year 2020 includes two full life cycles of salmon, giving a better view on the likely development of the stocks for a given exploitation rate. Year 2015 is more dependent on the current state of the stocks which varies between the rivers.

The simulations indicate that the smolt production is likely to increase compared to present situation in those rivers for which simulations are available (Figures 1 - 7) provided that the harvest rate in the off shore fishery is kept below 0.3 and there is no coastal fishery.

Under the assumption of no offshore or coastal fishing, the simulation results indicate that the probability for the ‘non weak’ stocks reaching 80 % of the potential smolt capacity by 2020 is between 72% and 87 %. The probability for the ‘weak’ stocks is between 3 and 80 % with no fishing. A harvest rate of 0.4 in the off shore fishery will reduce the probability of reaching 80% of potential smolt production for the ‘non weak’ stocks in 2020 by between 1 and 24 percentage points compared to the zero fishing scenario. For the ‘weak’ stocks, a harvest rate of 0.4 in the offshore fishery will reduce the probability of reaching 80 % by up to 28 percentage points for e.g. River Simojoki salmon stock.

The simulations assuming “min coastal effort” reduces the probabilities of reaching the target by up to 8 percentage points for the ‘non weak’ stocks and 13 percentage points for the ‘weak’ stocks. In the simulations, the coastal fishery is assumed to be highest on the northernmost stocks (0.2) and the reduction in the probability of achieving 80% of potential smolt production arising from the coastal fishery is therefore largest for those stocks.

The probability of a smolt production below 10 % of the potential smolt production (stock collapse) is less than 5 % for all stocks except for the Emån stock for all HRs evaluated assuming no coastal fishery takes place. Under the assumption of a coastal fishery, the probability of stock collapse increases substantially for all ‘weak’ stocks.

The simulations suggest the following approximate long-term catches for the harvest rate options (in off shore fisheries):

| Harvest rate | Catch in numbers in off shore fishery (‘000 salmon) |
|---|---|
| **0,1** | 80 |
| **0,2** | 132 |
| **0,3** | 183 |
| **0,4** | 234 |

The size of the unexploited reared salmon stock in all assessment units is estimated to be somewhat above 230,000 for a HR of 0.2 and about 200,000 for a HR of 0.4. These are the same or lower than historical estimates (the peak was in 1998).

**STECF conclusions**

STECF notes that the simulations do not include stocks from AU5-6 rivers which in general hold the weakest salmon stock in the Baltic. The Môrrumåen and Emån stocks have been used as indicators for the weak stocks in AU5-6. STECF does not have the information required to judge if these two stocks give a reliable indication of the likely response of the weak AU5-6 stocks to the different HRs.

Simulation results indicate that any mixed salmon fishery will results in a probability of 9 % for stock collapse in River Emån (year 2020) and 3 % probability in Rickleån. These stocks may have similar productivity to the 'weak' Main Basin stocks, which have not been included in the simulations undertaken.

The genetic population structure of the Baltic salmon has been studied in detail (e.g. Säisä et al 2005). In summary, there are three main groups of populations: northern (Gulf of Bothnia, WGBAST assessment units 1-3), southern (western Baltic Main Basin, WGBAST assessment units 4), and eastern (Gulf of Finland and eastern Baltic Main Basin, WGBAST assessment units 5 & 6). These groups are assumed to mirror three distinct colonisation events (Säisä et al 2005). About 5 % of the total genetic diversity in the Baltic Sea is explained by differences between stocks within groups, whereas a bit more (6%) is explained by differences between groups (northern vs southern vs eastern) (Säisä et al 2005). Thus, a large part of the interpopulation variation in the Baltic is found between these areas.

From a conservation genetic perspective, it is important that the future management plan takes into account the population genetic structure within the Baltic salmon in order to maintain genetic variability, local adaptations and secure future evolutionary potential in all rivers with wild salmon production. In fact, although the current management plan does not include any specific genetic objectives, the plan indirectly work to some extent to safeguard the genetic population structure of wild stocks by setting river-specific smolt production objectives. However, genetic objectives have been suggested to be included in a more direct way in the new management plan (ICES 2008).

STECF furthermore notes that the simulation results also indicate that permitting a coastal fishery in combination with the simulated HRs in the off shore fishery markedly increases the risk of stock collapse in the weak stocks. For example, for a HR in the offshore fishery of 0.1, the probability of collapse by 2020 of the Rickleån stock increased from 0.02 with no coastal fishery to 0.64 if a coastal fishery is included in the simulation. Note that in the simulations, the effort levels assumed for the coastal fishery was equivalent to the lowest historically estimated effort and was at the same level as that assumed in latest ICES advice. This fishery takes place mainly by trapnets along the coast and close to rivers

At its 32$^{nd}$ plenary meeting STECF (STECF_PLEN 09-03) was requested to provide fishing opportunities for Baltic salmon consistent with less than a 5% risk of stock collapse. In response to that request STECF advised the following:

*"STECF advises that in the current situation with a number of wild salmon stocks being at low levels, any fishery on mixed stocks offshore or coastal will most likely constitute a risk of collapse of more than 5% to the weakest stocks. STECF therefore advise that under the 5% risk criteria no commercial or recreational fishing of mixed salmon stocks should be allowed until the management target (recover all stocks to 80% of maximum smolt production) has been reached for all stocks".*

The results of the simulations presented here confirm that in order to achieve a probability of stock collapse of less than 5%, no commercial or recreational fishing of mixed salmon stocks should be permitted.

ICES 2008. Workshop on Baltic Salmon Management Plan Request (WKBALSAL). ICES CM 2008/ACOM:55.

Marjatta Säisä, Marja-Liisa Koljonen, Riho Gross, Jan Nilsson, Jaana Tähtinen, Jarmo Koskiniemi, and Anti Vasemägi 2005. Population genetic structure and postglacial colonization of Atlantic salmon (*Salmo salar*) in the Baltic Sea area based on microsatellite DNA variation. *Can. J. Fish. Aquat. Sci.* **62**: 1887–1904.

## Acknowledgements

STECF acknowledges Atso Romakkaniemi and Henni Pulkkinen, Finnish Game and Fisheries Research Institute for their willingness to undertake the simulations required to respond to this request and their enthusiasm to provide the results. STECF is extremely appreciative of their co-operation and professionalism, without which STECF would have been unable to provide an informed response in the time available.

Table 1. The probabilities to reach the 10 % (risk definition by STECF) and the 80 % (MSY related target) of 15 Baltic rivers. Each stock has a probabilistic S/R model and area specific exploitation rates.

The minimum coastal effort option is explained in the method -
section.

**Probability to reach 10% of potential smolt production capacity by 2015**

| | **CHR 3SW** | **Tornionjoki** | **Simojoki** | **Kalixälven** | **Råneälven** | **Piteälven** | **Åbyälven** | **Byskeälven** | **Rickleån** | **Sävarån** | **Ume/ Vindelälven** | **Öreälven** | **Lögdeälven** | **Ljungan** | **Mörrumsån** | **Emån** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 |
| No coastal | **0.1** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.92 |
| fishery | **0.2** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.90 |
| | **0.3** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.96 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.85 |
| | **0.4** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 0.78 |
| min coastal | **0.1** | 0.76 | 0.47 | 0.83 | 0.69 | 0.86 | 0.80 | 0.83 | 0.24 | 0.59 | 0.86 | 0.47 | 0.63 | 0.67 | 0.50 | 0.00 |
| effort | **0.3** | 0.71 | 0.42 | 0.83 | 0.67 | 0.85 | 0.78 | 0.83 | 0.23 | 0.56 | 0.85 | 0.42 | 0.58 | 0.63 | 0.40 | 0.00 |

**Probability to reach 10% of potential smolt production capacity by 2020**

| | **CHR 3SW** | **Tornionjoki** | **Simojoki** | **Kalixälven** | **Råneälven** | **Piteälven** | **Åbyälven** | **Byskeälven** | **Rickleån** | **Sävarån** | **Ume/ Vindelälven** | **Öreälven** | **Lögdeälven** | **Ljungan** | **Mörrumsån** | **Emån** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.94 |
| No coastal | **0.1** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 0.91 |
| fishery | **0.2** | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 0.86 |
| | **0.3** | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.96 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 0.80 |
| | **0.4** | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 0.72 |
| min coastal | **0.1** | 0.77 | 0.37 | 0.82 | 0.72 | 0.84 | 0.80 | 0.83 | 0.36 | 0.66 | 0.85 | 0.61 | 0.71 | 0.65 | 0.77 | 0.01 |
| effort | **0.3** | 0.71 | 0.25 | 0.80 | 0.65 | 0.83 | 0.73 | 0.81 | 0.33 | 0.60 | 0.85 | 0.53 | 0.66 | 0.60 | 0.61 | 0.01 |

**Probability to reach 80% of potential smolt production capacity by 2015**

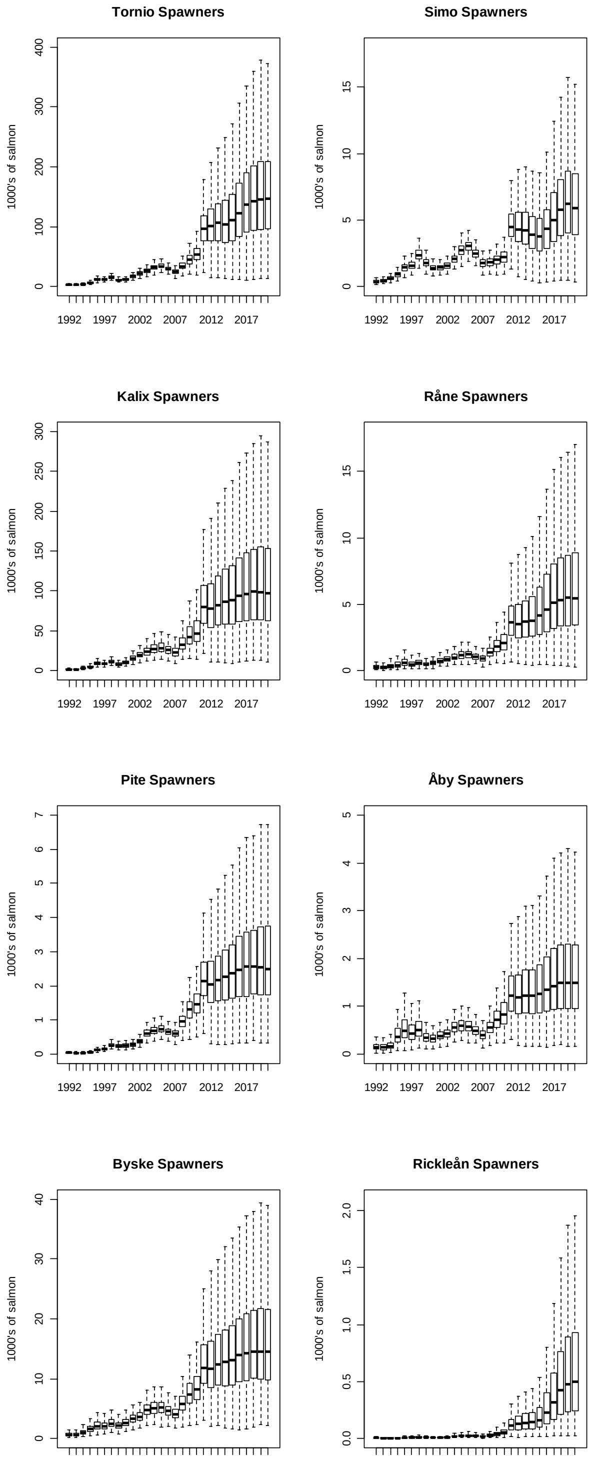
| | CHR 3SW | Tornionjoki | Simojoki | Kalixälven | Råneälven | Piteälven | Åbyälven | Byskeälven | Rickleån | Sävarån | Ume/Vindelälven | Öreälven | Lögdeälven | Ljungan | Mörrumsån | Emån |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | 0.83 | 0.61 | 0.85 | 0.72 | 0.88 | 0.85 | 0.86 | 0.31 | 0.67 | 0.86 | 0.54 | 0.69 | 0.72 | 0.56 | 0.00 |
| No coastal | **0.1** | 0.82 | 0.60 | 0.86 | 0.74 | 0.85 | 0.85 | 0.84 | 0.28 | 0.64 | 0.86 | 0.53 | 0.67 | 0.69 | 0.53 | 0.00 |
| fishery | **0.2** | 0.79 | 0.56 | 0.86 | 0.74 | 0.88 | 0.82 | 0.86 | 0.28 | 0.61 | 0.86 | 0.51 | 0.65 | 0.69 | 0.45 | 0.00 |
| | **0.3** | 0.79 | 0.55 | 0.84 | 0.71 | 0.86 | 0.82 | 0.85 | 0.27 | 0.60 | 0.86 | 0.48 | 0.66 | 0.68 | 0.42 | 0.00 |
| | **0.4** | 0.76 | 0.48 | 0.84 | 0.69 | 0.88 | 0.82 | 0.83 | 0.24 | 0.57 | 0.87 | 0.44 | 0.61 | 0.66 | 0.34 | 0.00 |
| min coastal | **0.1** | 0.76 | 0.47 | 0.83 | 0.69 | 0.86 | 0.80 | 0.83 | 0.24 | 0.59 | 0.86 | 0.47 | 0.63 | 0.67 | 0.50 | 0.00 |
| effort | **0.3** | 0.71 | 0.42 | 0.83 | 0.67 | 0.85 | 0.78 | 0.83 | 0.23 | 0.56 | 0.85 | 0.42 | 0.58 | 0.63 | 0.40 | 0.00 |

**Probability to reach 80% of potential smolt production capacity by 2020**

| | CHR 3SW | Tornionjoki | Simojoki | Kalixälven | Råneälven | Piteälven | Åbyälven | Byskeälven | Rickleån | Sävarån | Ume/Vindelälven | Öreälven | Lögdeälven | Ljungan | Mörrumsån | Emån |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | 0.79 | 0.50 | 0.87 | 0.76 | 0.86 | 0.83 | 0.86 | 0.42 | 0.72 | 0.86 | 0.70 | 0.74 | 0.74 | 0.80 | 0.03 |
| No coastal | **0.1** | 0.82 | 0.44 | 0.86 | 0.74 | 0.85 | 0.82 | 0.86 | 0.40 | 0.69 | 0.84 | 0.65 | 0.74 | 0.69 | 0.77 | 0.01 |
| fishery | **0.2** | 0.79 | 0.38 | 0.82 | 0.72 | 0.86 | 0.81 | 0.82 | 0.37 | 0.65 | 0.87 | 0.62 | 0.74 | 0.67 | 0.69 | 0.01 |
| | **0.3** | 0.76 | 0.33 | 0.83 | 0.70 | 0.84 | 0.80 | 0.81 | 0.35 | 0.63 | 0.86 | 0.60 | 0.67 | 0.65 | 0.62 | 0.00 |
| | **0.4** | 0.72 | 0.26 | 0.80 | 0.68 | 0.83 | 0.76 | 0.81 | 0.33 | 0.58 | 0.85 | 0.54 | 0.65 | 0.60 | 0.52 | 0.00 |
| min coastal | **0.1** | 0.77 | 0.37 | 0.82 | 0.72 | 0.84 | 0.80 | 0.83 | 0.36 | 0.66 | 0.85 | 0.61 | 0.71 | 0.65 | 0.77 | 0.01 |
| effort | **0.3** | 0.71 | 0.25 | 0.80 | 0.65 | 0.83 | 0.73 | 0.81 | 0.33 | 0.60 | 0.85 | 0.53 | 0.66 | 0.60 | 0.61 | 0.01 |

**Fig. 1. Assumptions in the model run:**
Cumulative harvest rate for 3SW salmon is 0 from 2011.
No coastal fishery from 2011
No river fishery for Simo, Rickleån, Öre, Mörrumsån or Emån from 2011.

Fig 1a. Development of spawning populations.Distrubtions include median, 50 % and 95 confidence intervals.



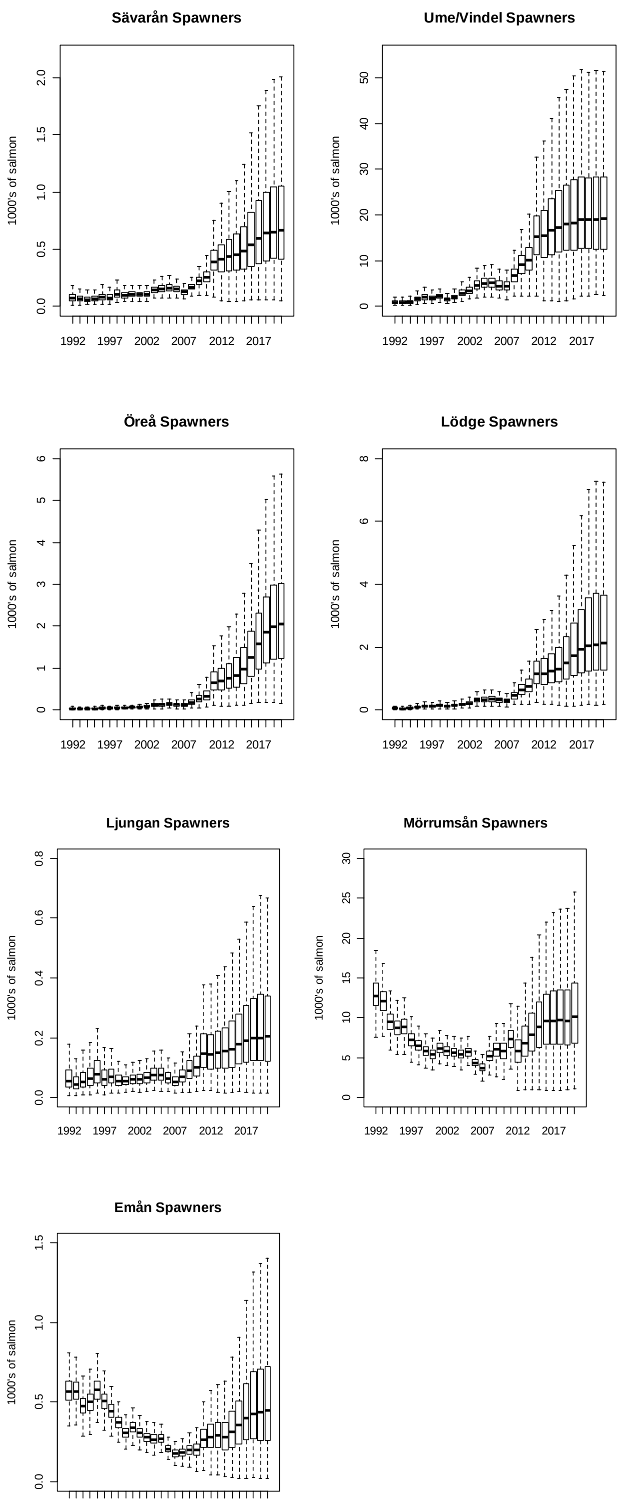

Sävarån Spawners
Ume/Vindel Spawners
Öreå Spawners
Lödge Spawners
Ljungan Spawners
Mörrumsån Spawners
Emån Spawners
1000's of salmon
1992
1997
2002
2007
2012
2017

Figure 1b. Probability of achieving a minimum of 80% of potential smolt production by assessment Unit

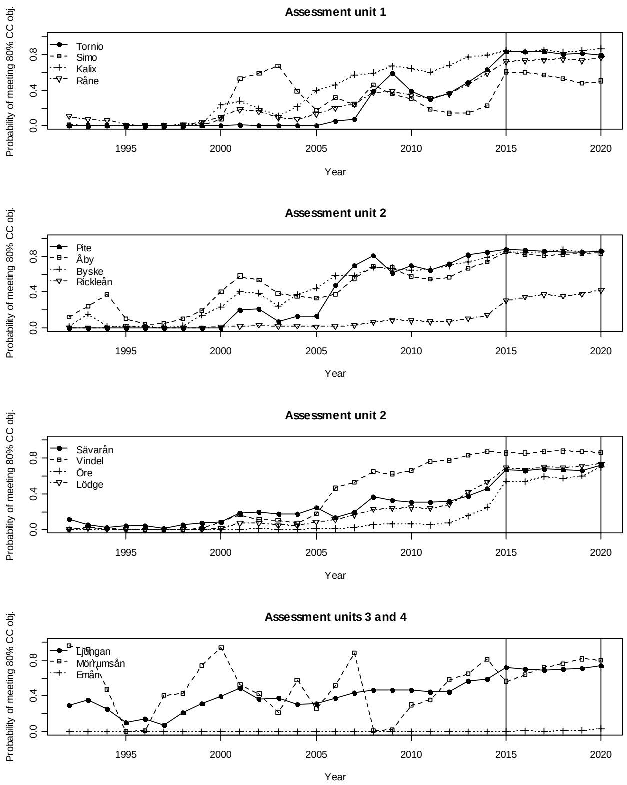



Figure 1c. Estimated numbers of unexploited reared salmon by assessment unit .

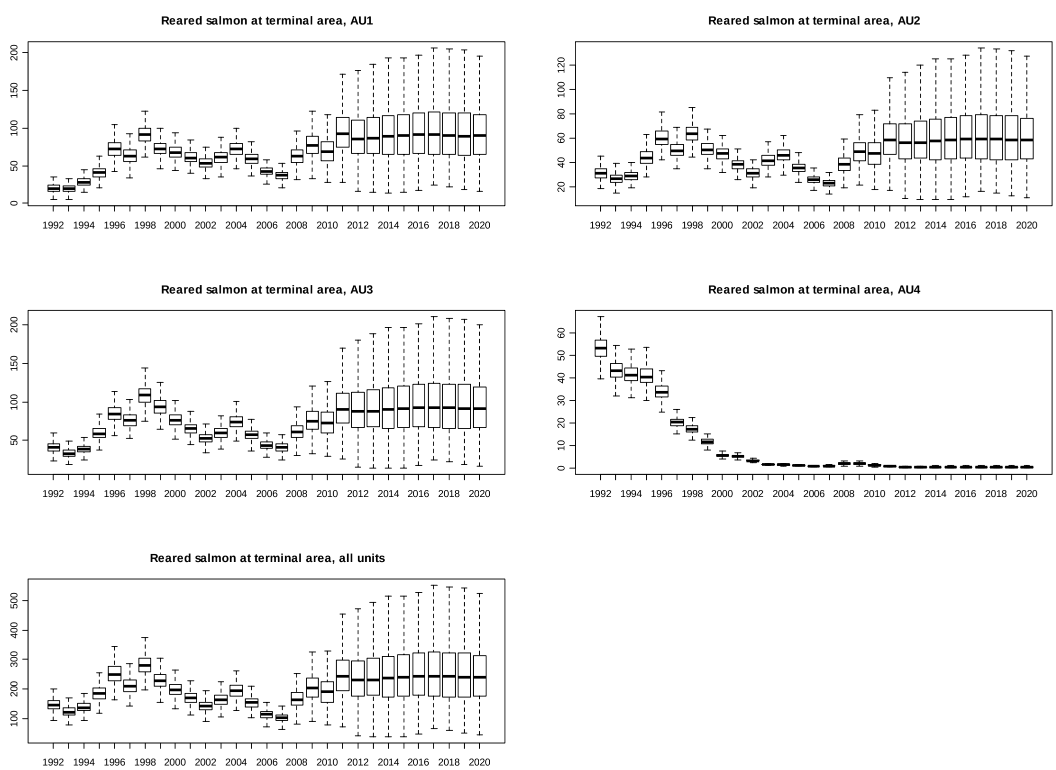


Figure 1d. Predicted coastal and offshore catches

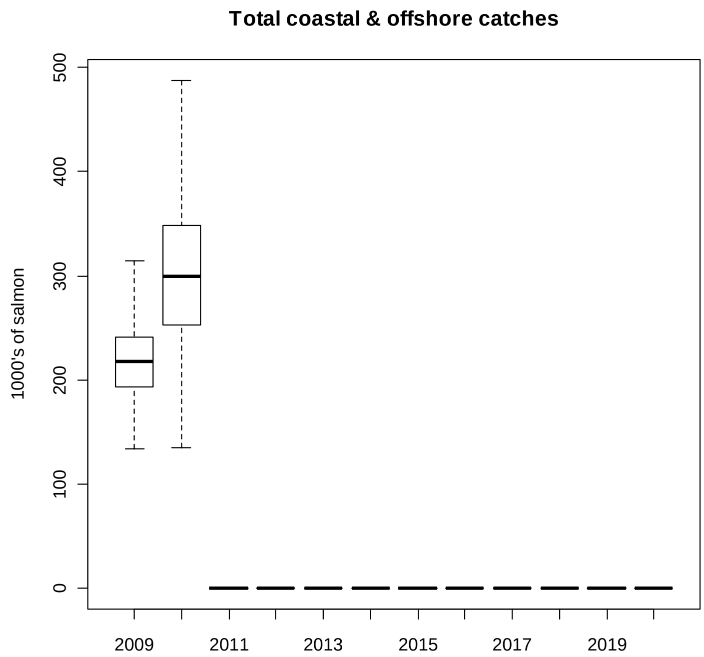
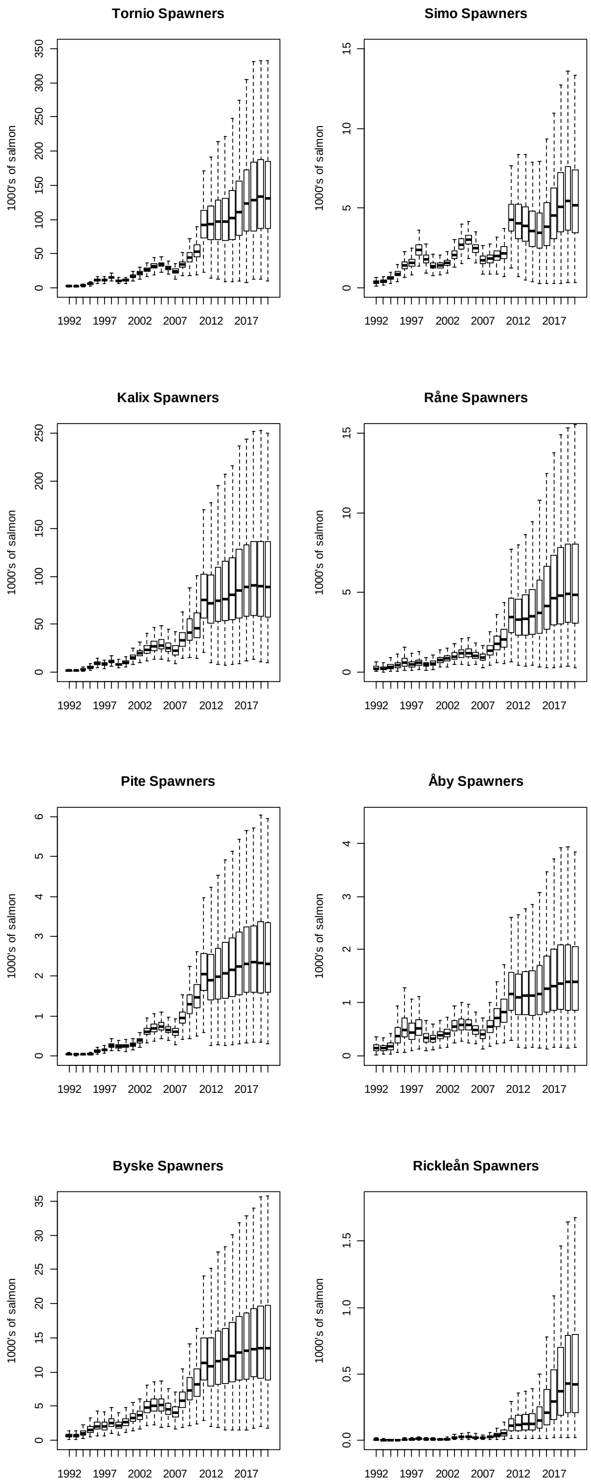


**Figure. 2. Results of simulations for the following HR scenario.**
Cumulative harvest rate for 3SW salmon is 0.1 after 2011.
No coastal fishery
No river fishery for Simo, Rickleån, Öre, Mörrumsån or Emån.

Fig 2a. Development of spawning populations



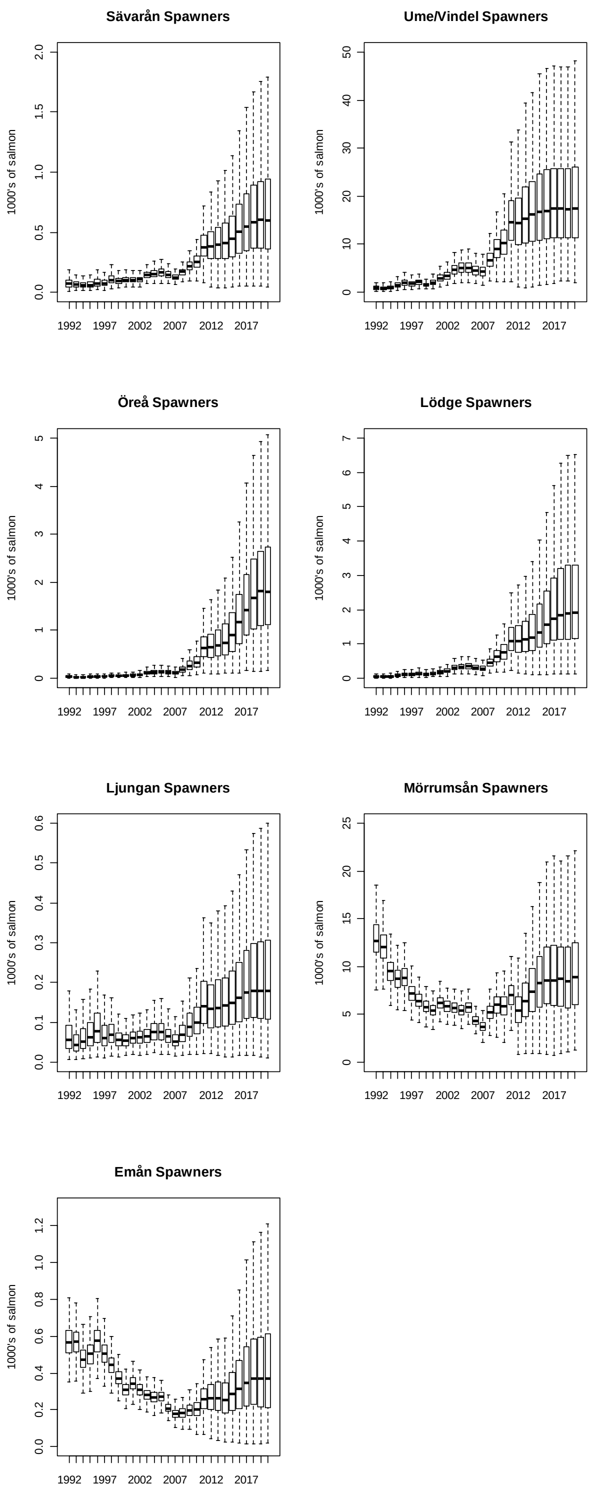

Sävarån Spawners
Ume/Vindel Spawners
Öreå Spawners
Lödge Spawners
Ljungan Spawners
Mörrumsån Spawners
Emån Spawners
1000's of salmon
1992
1997
2002
2007
2012
2017

Figure 2b. Probability of achieving a minimum of 80% of potential smolt production by assessment Unit

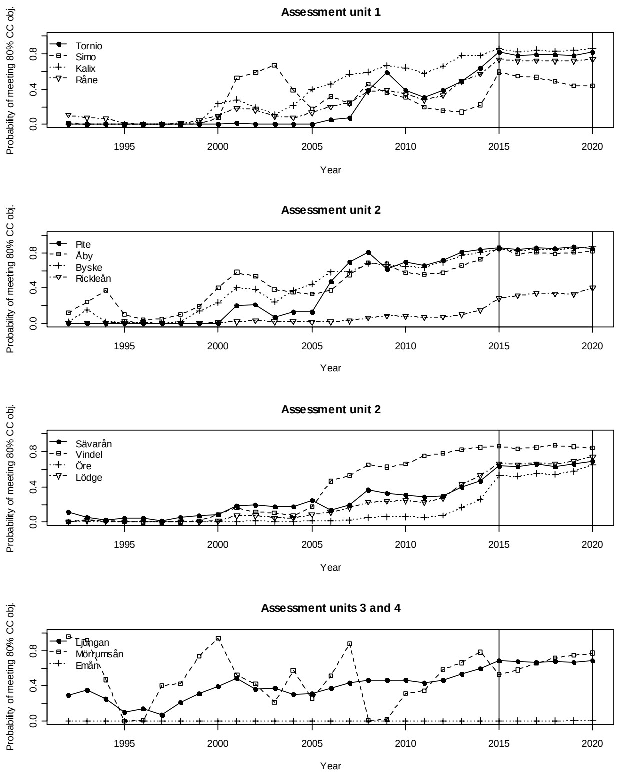



Figure 2c. Estimated numbers of unexploited reared salmon by assessment unit .

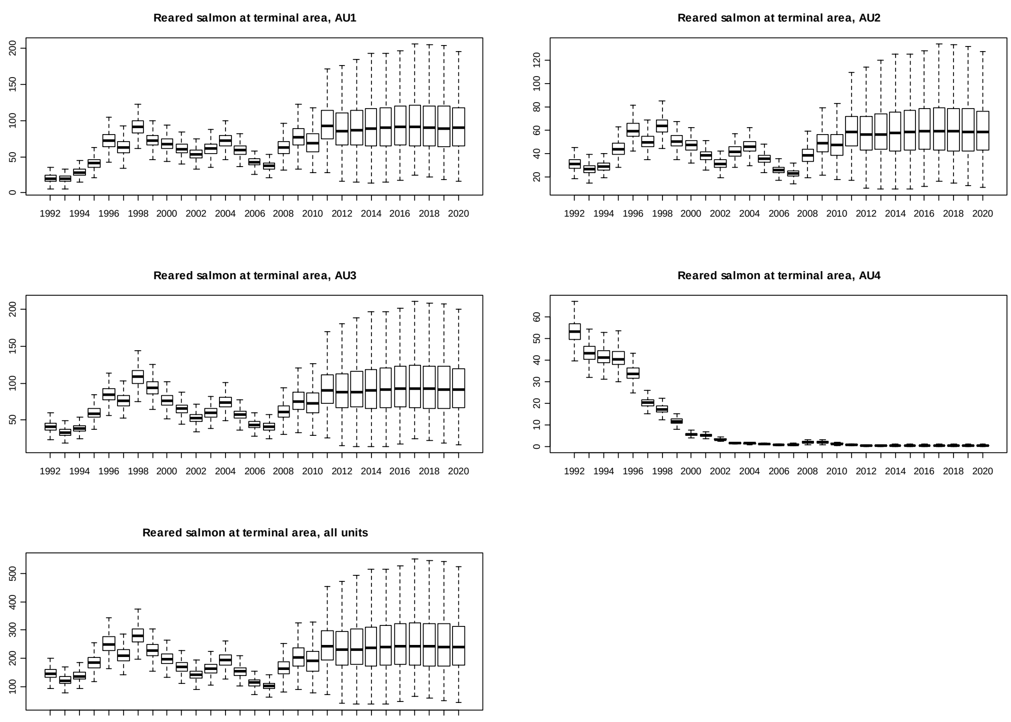


Figure 2d. Predicted coastal and offshore catches

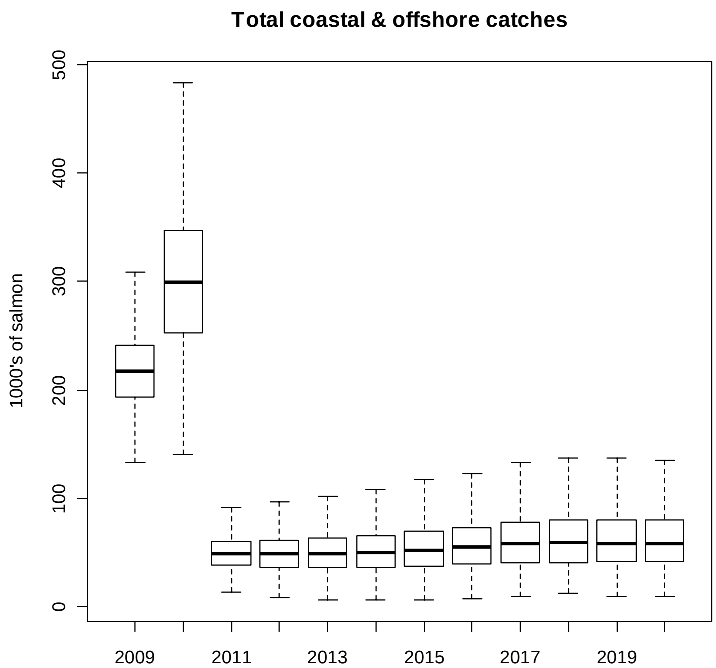
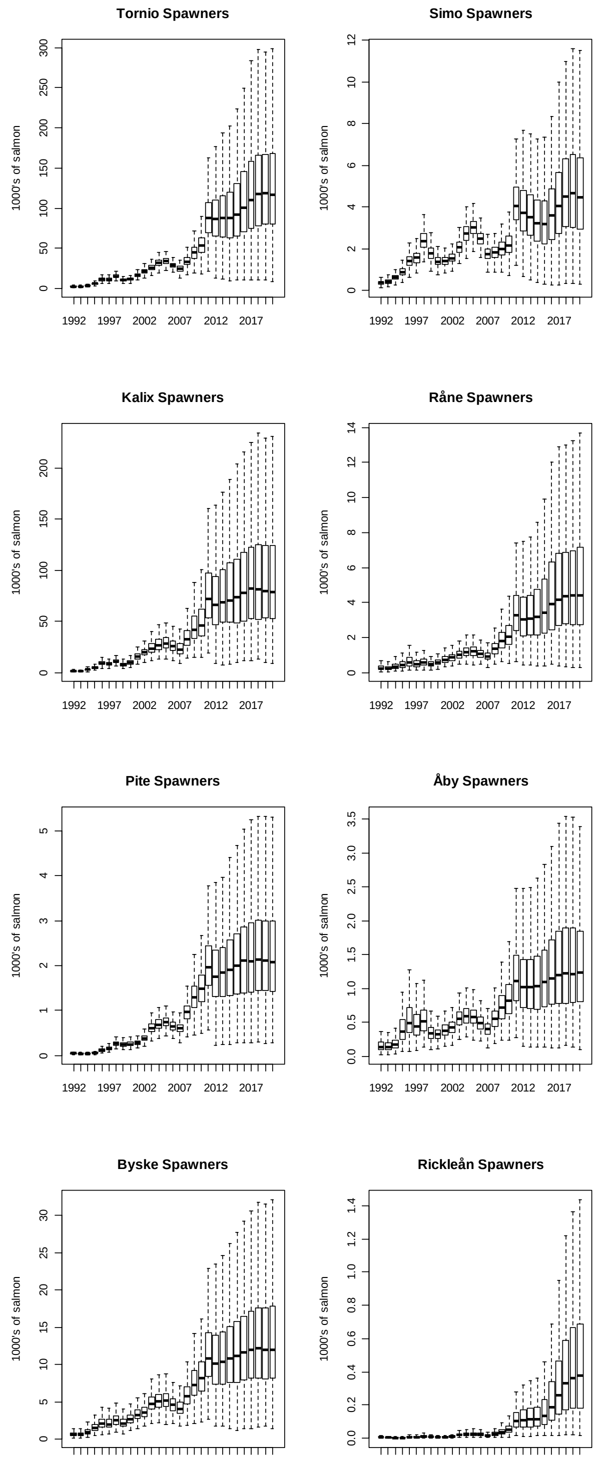


**Figure. 3. Results of simulations for the following HR scenario.**
Cumulative harvest rate for 3SW salmon is 0.2 from 2011.
No coastal fishery from 2011
No river fishery for Simo, Rickleån, Öre, Mörrumsån or Emån from 2011.

Fig 3a. Development of spawning populations



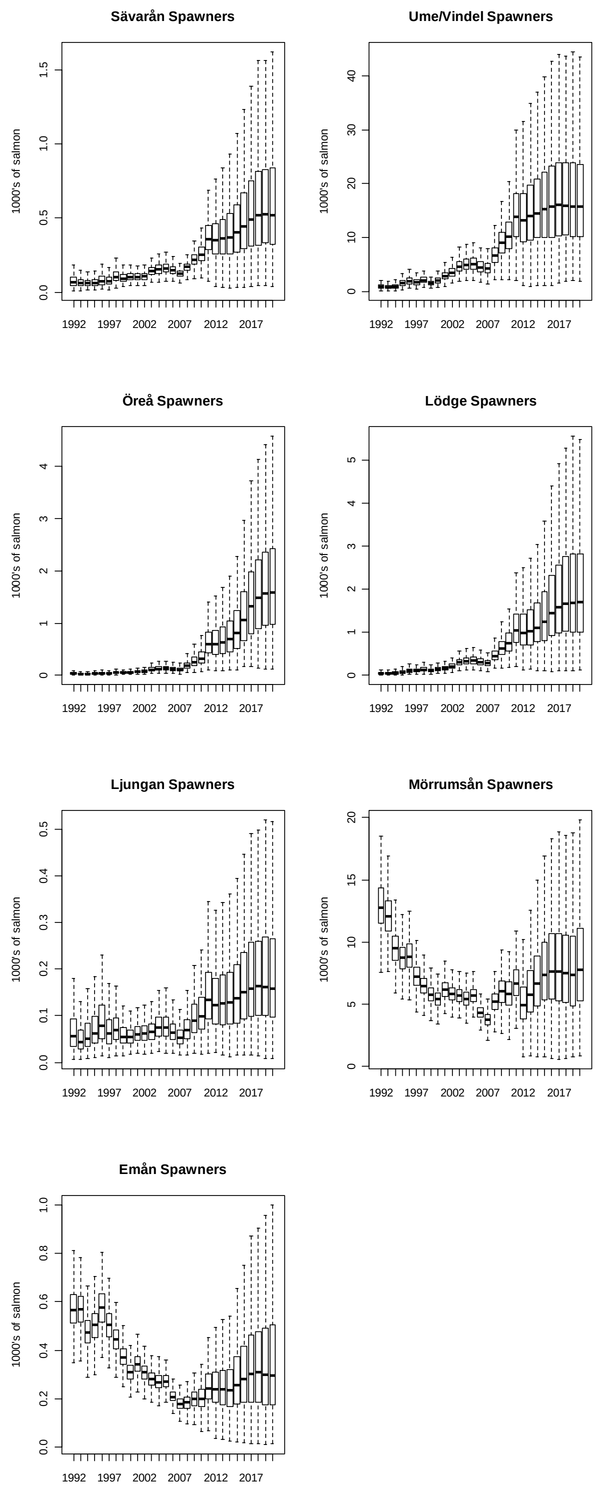

Sävarån Spawners
1000's of salmon
0.0
0.5
1.0
1.5
1992
1997
2002
2007
2012
2017
Ume/Vindel Spawners
1000's of salmon
0
10
20
30
40
1992
1997
2002
2007
2012
2017
Öreå Spawners
1000's of salmon
0
1
2
3
4
1992
1997
2002
2007
2012
2017
Lödge Spawners
1000's of salmon
0
1
2
3
4
5
1992
1997
2002
2007
2012
2017
Ljungan Spawners
1000's of salmon
0.0
0.1
0.2
0.3
0.4
0.5
1992
1997
2002
2007
2012
2017
Mörrumsån Spawners
1000's of salmon
0
5
10
15
20
1992
1997
2002
2007
2012
2017
Emån Spawners
1000's of salmon
0.0
0.2
0.4
0.6
0.8
1.0
1992
1997
2002
2007
2012
2017

Figure 3b. Probability of achieving a minimum of 80% of potential smolt production by assessment Unit

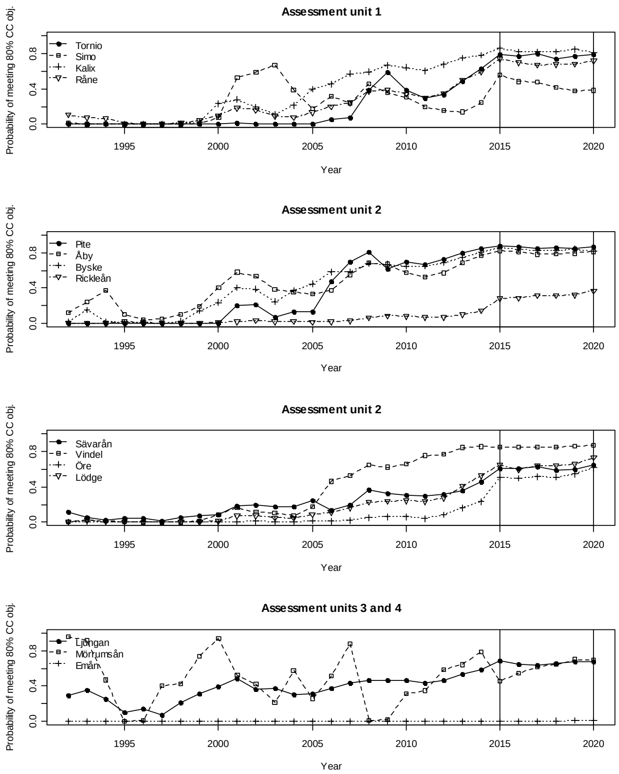



Figure 3c. Estimated numbers of unexploited reared salmon by assessment unit.

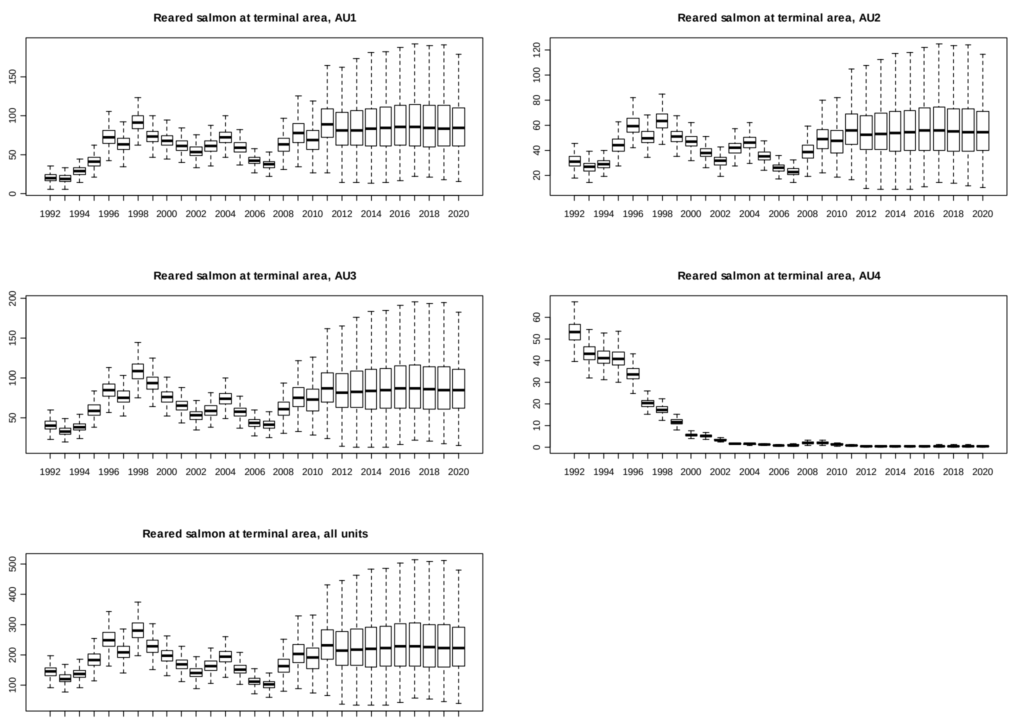


Figure 3d. Predicted coastal and offshore catches

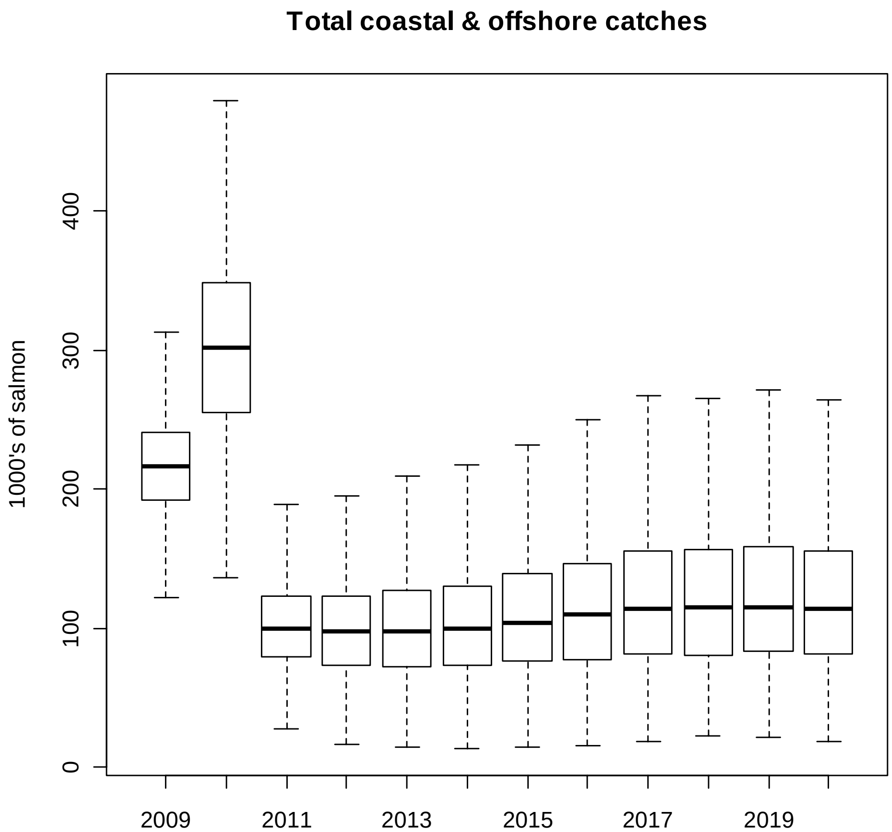
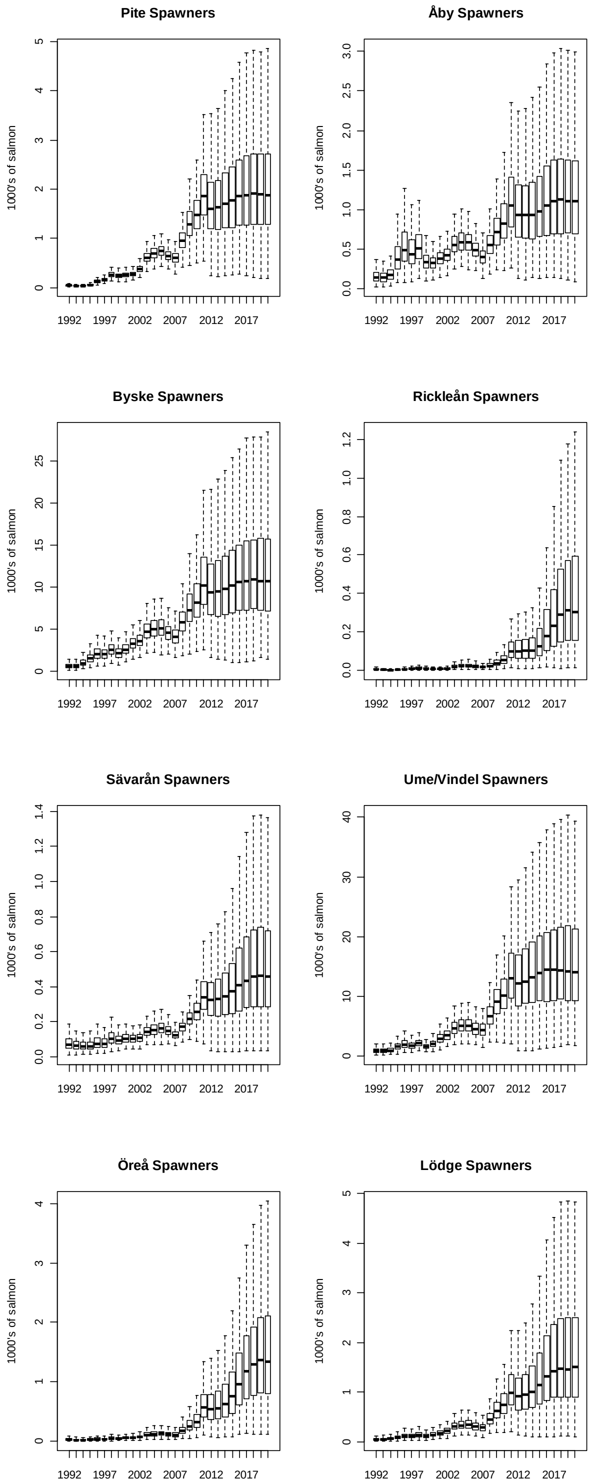


**Figure. 4. Results of simulations for the following HR scenario.**
Cumulative harvest rate for 3SW salmon is 0.3 from 2011.
No coastal fishery from 2011
No river fishery for Simo, Rickleån, Öre, Mörrumsån or Emån from 2011.

Fig 4a. Development of spawning populations



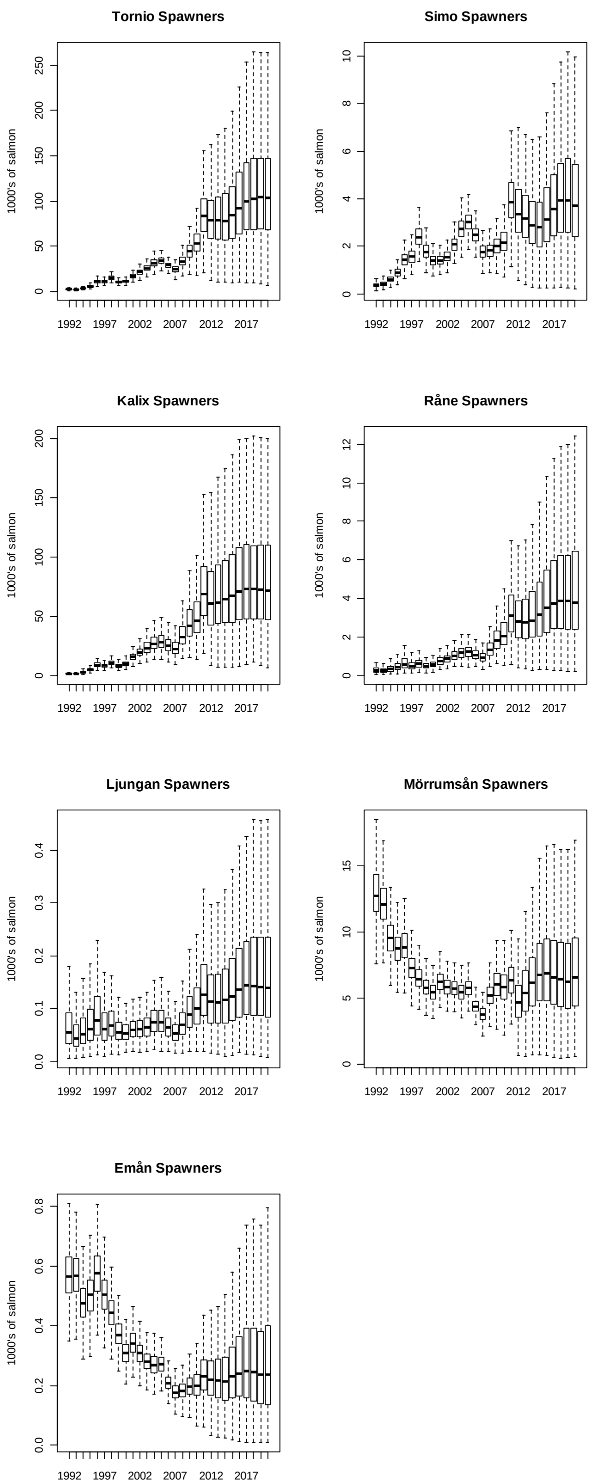

Tornio Spawners
Simo Spawners
Kalix Spawners
Råne Spawners
Ljungan Spawners
Mörrumsån Spawners
Emån Spawners
1000's of salmon
1992
1997
2002
2007
2012
2017

Figure 4b. Probability of achieving a minimum of 80% of potential smolt production by assessment Unit

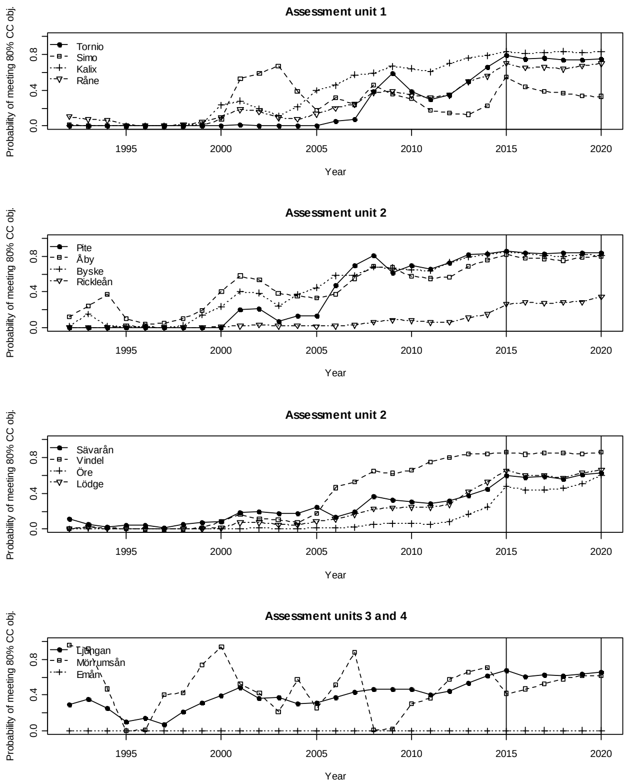



Figure 4c. Estimated numbers of unexploited reared salmon by assessment unit

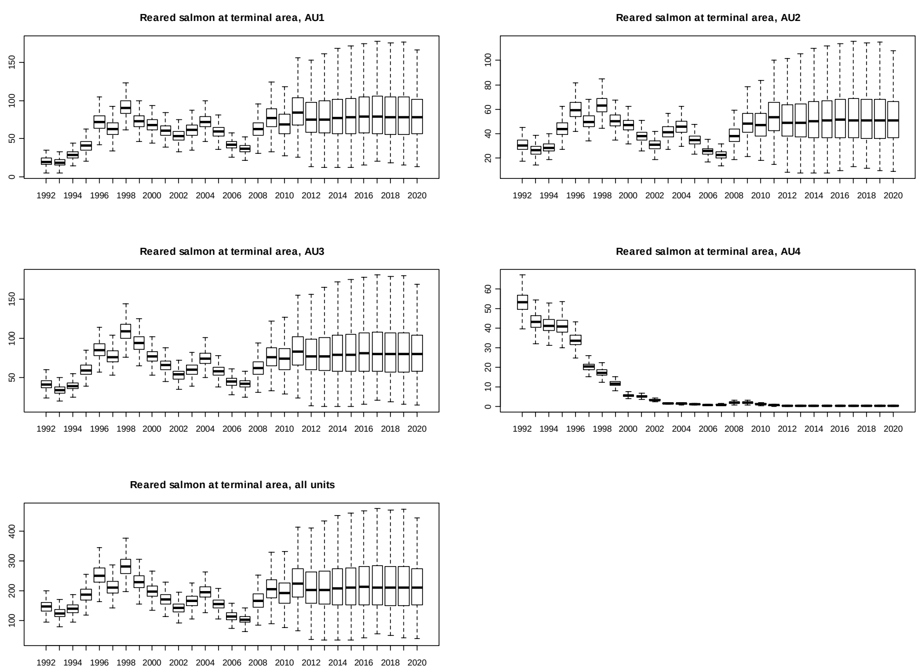


Figure 4d. Predicted coastal and offshore catches

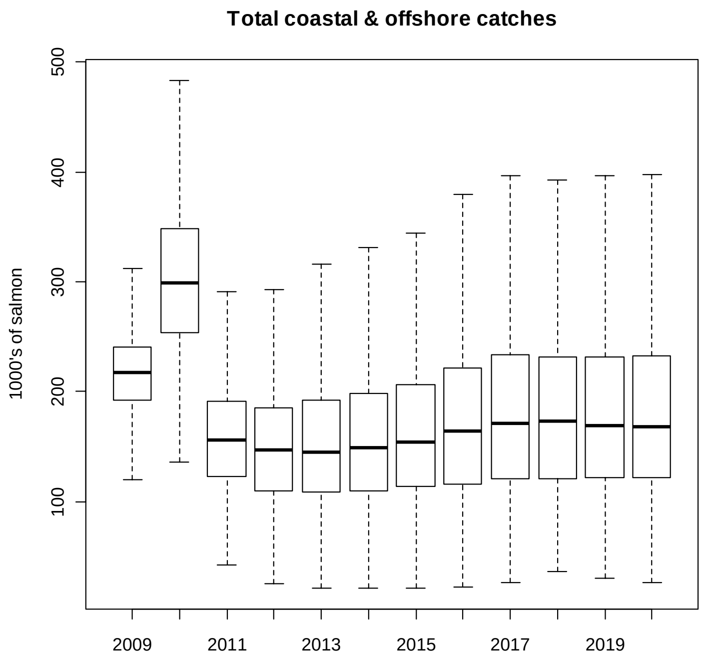
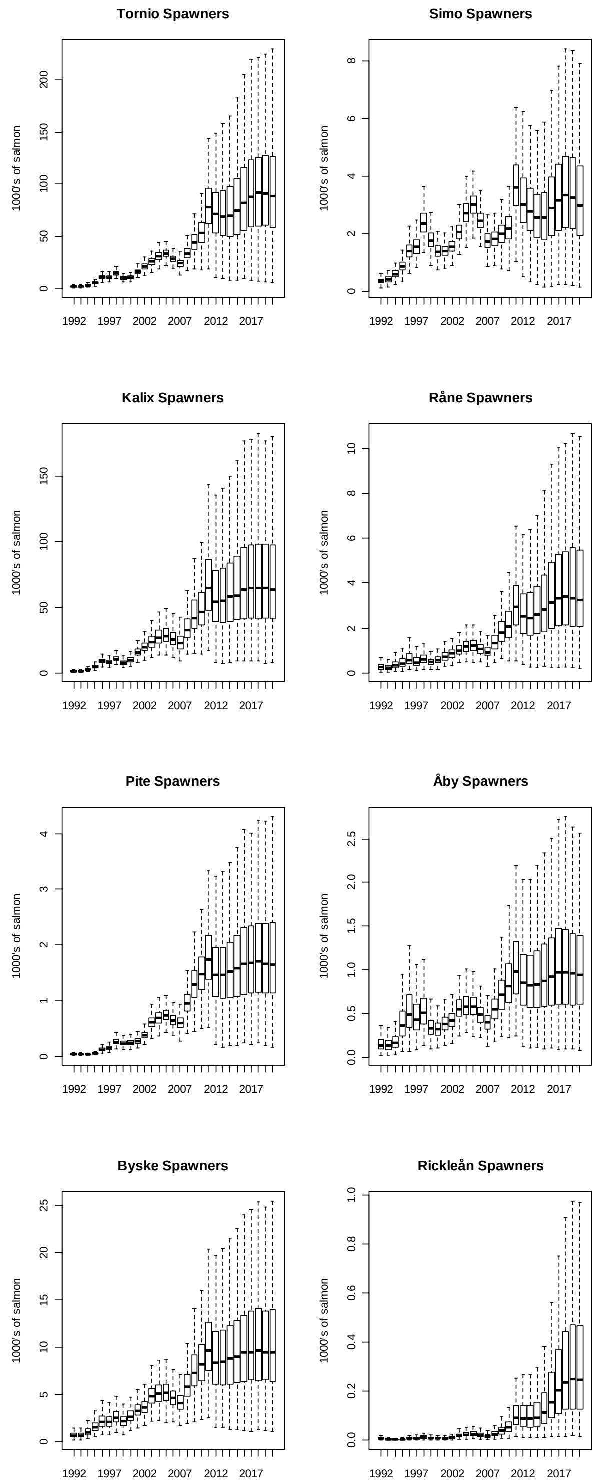


**Figure. 5. Results of simulations for the following HR scenario.**
Cumulative harvest rate for 3SW salmon is 0.4 from 2011.
No coastal fishery from 2011
No river fishery for Simo, Rickleån, Öre, Mörrumsån or Emån from 2011.

Fig 5a. Development of spawning populations



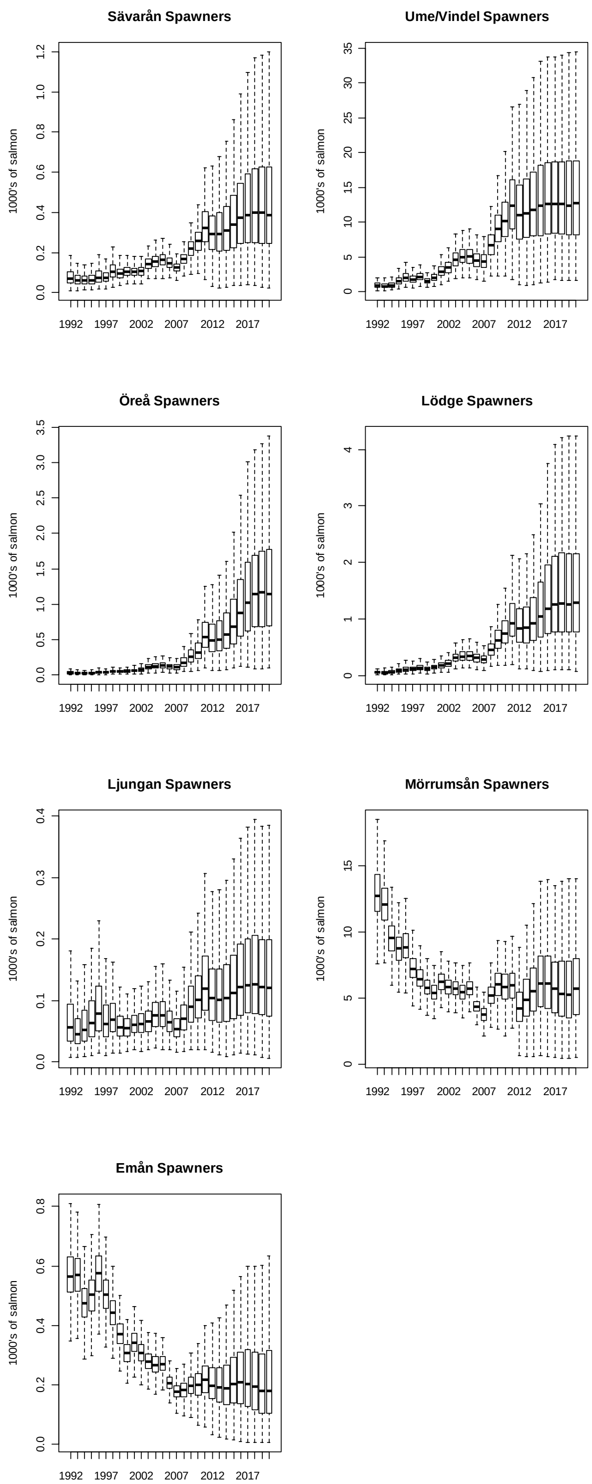

Sävarån Spawners
1000's of salmon
0.0 0.2 0.4 0.6 0.8 1.0 1.2
Ume/Vindel Spawners
1000's of salmon
0 5 10 15 20 25 30 35
Öreå Spawners
1000's of salmon
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5
Lödge Spawners
1000's of salmon
0 1 2 3 4
Ljungan Spawners
1000's of salmon
0.0 0.1 0.2 0.3 0.4
Mörrumsån Spawners
1000's of salmon
0 5 10 15
Emån Spawners
1000's of salmon
0.0 0.2 0.4 0.6 0.8
1992 1997 2002 2007 2012 2017

Figure 5b. Probability of achieving a minimum of 80% of potential smolt production by assessment Unit

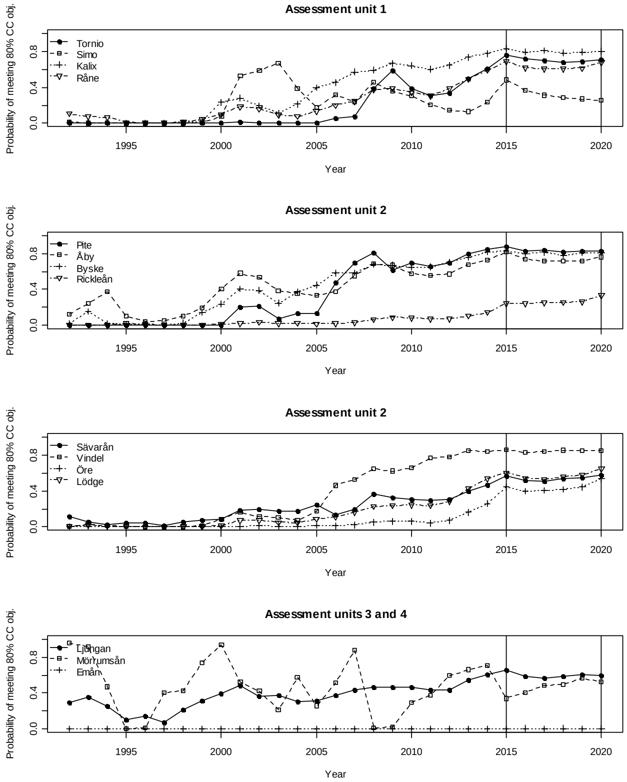



Figure 5c. Estimated numbers of unexploited reared salmon by assessment unit.

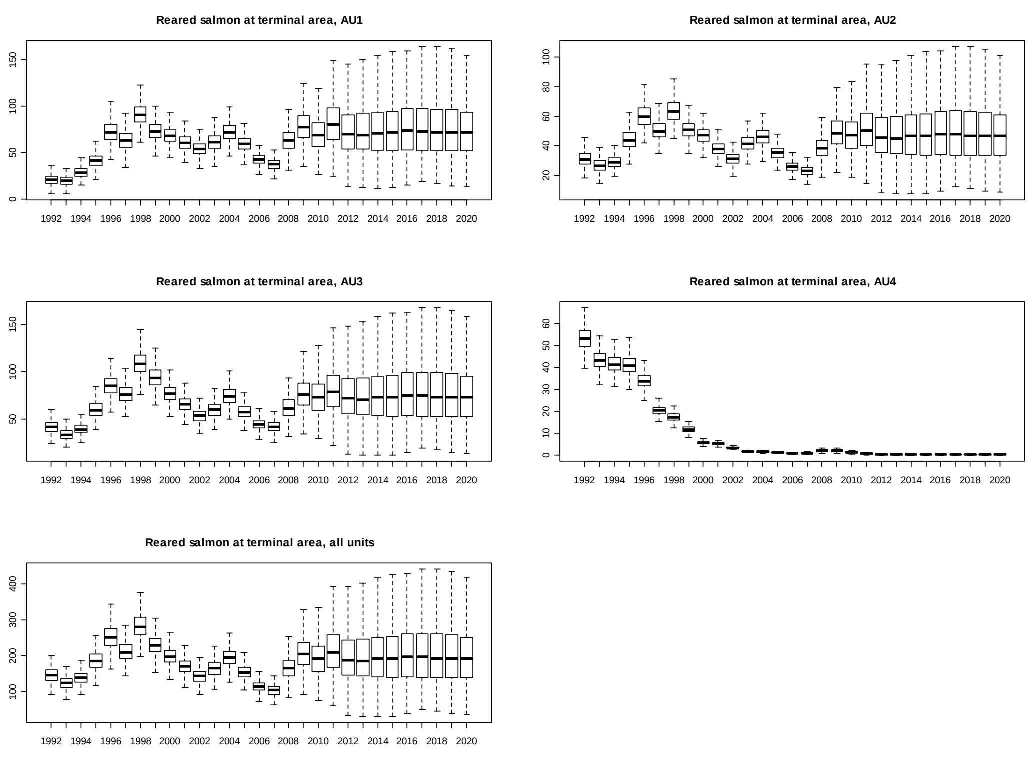


Figure 5d. Predicted coastal and offshore catches

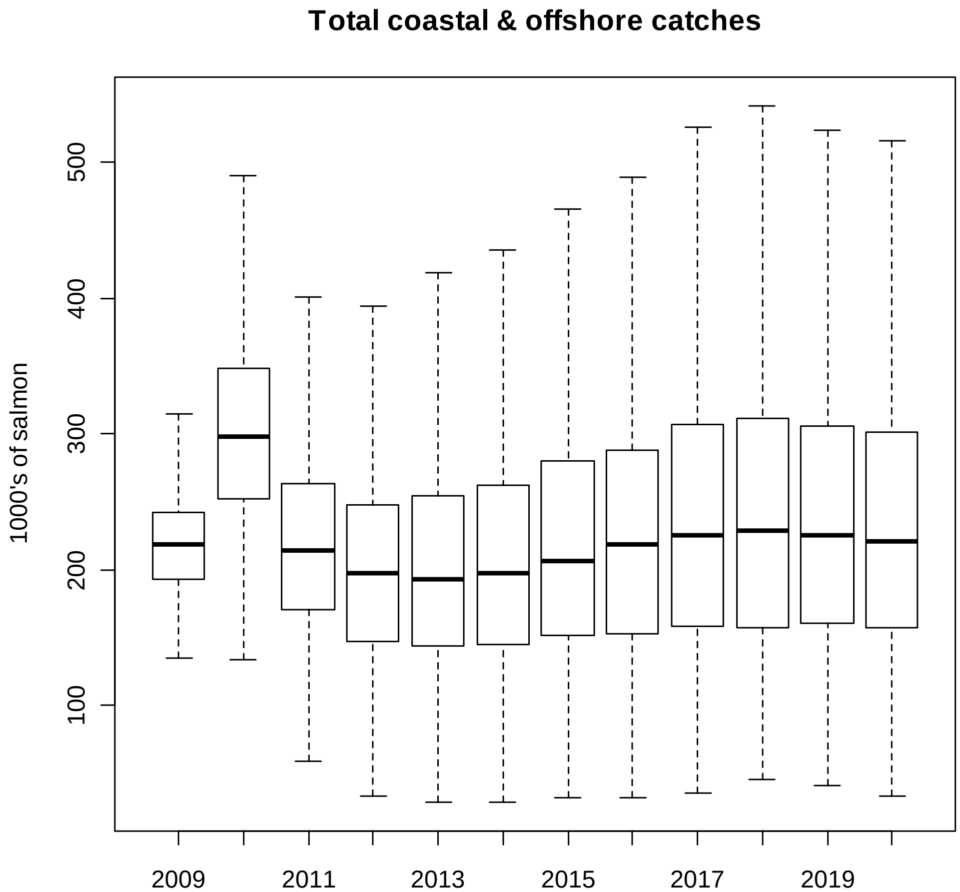
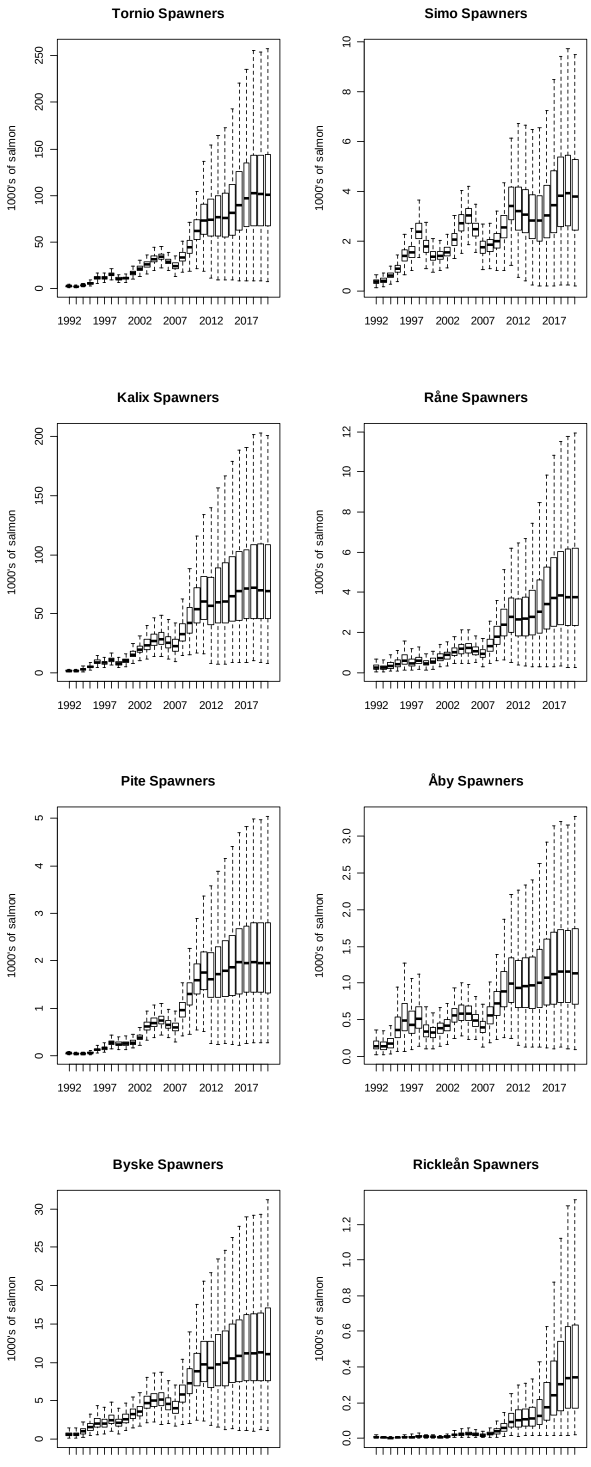


**Figure. 6. Results of simulations for the following HR scenario.**
Cumulative harvest rate for 3SW salmon is 0.1 after 2011.
Minimum coastal effort.
No river fishery for Simo, Rickleån, Öre, Mörrumsån or Emån.

Fig 6a. Development of spawning populations



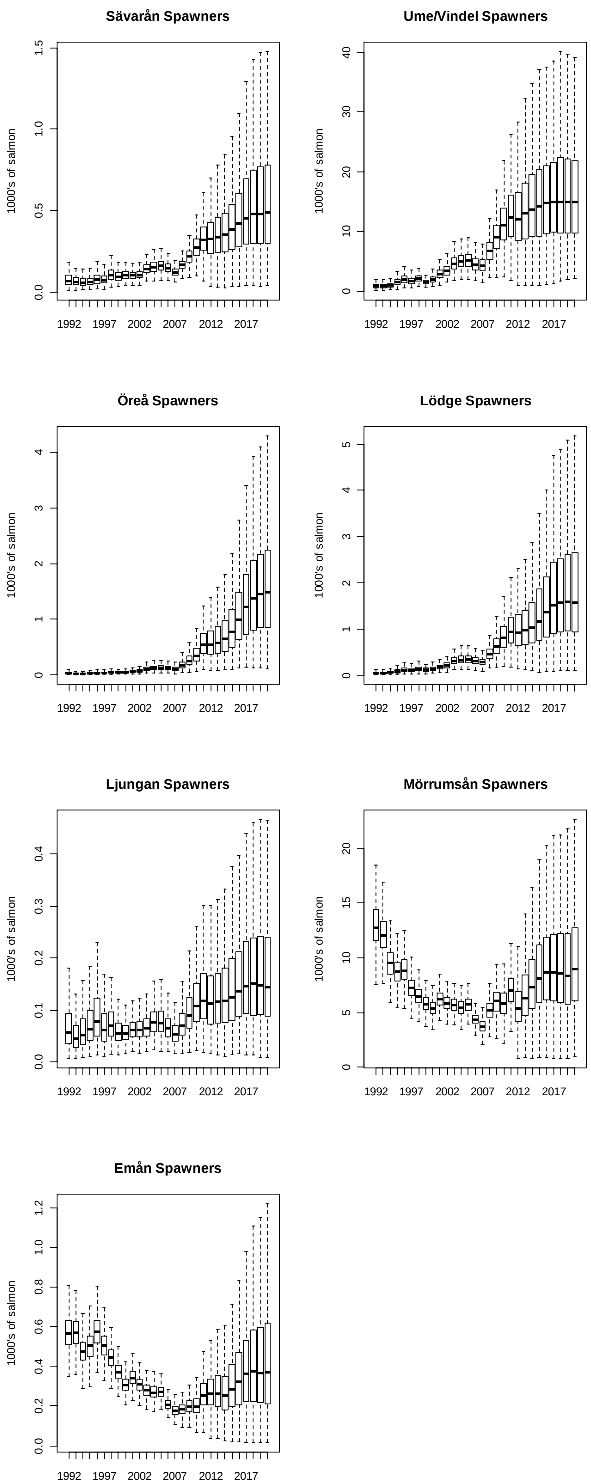

Sävarån Spawners
Ume/Vindel Spawners
Öreå Spawners
Lödge Spawners
Ljungan Spawners
Mörrumsån Spawners
Emån Spawners
1000's of salmon
1992
1997
2002
2007
2012
2017

Figure 6b. Probability of achieving a minimum of 80% of potential smolt production by assessment Unit

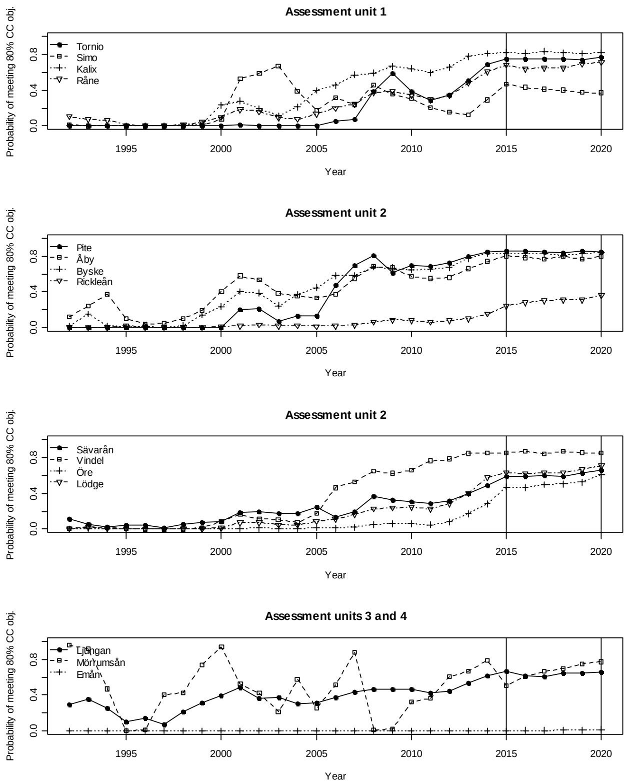



Figure 6c. Estimated numbers of unexploited reared salmon by assessment unit

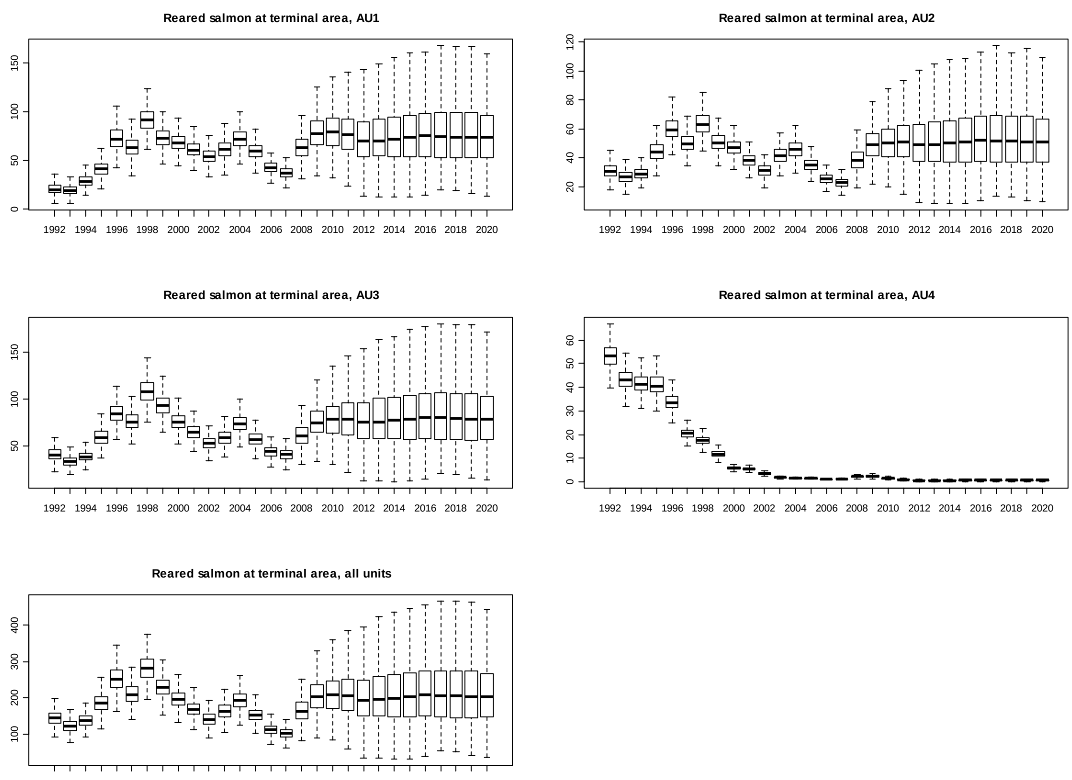


Figure 6d. Predicted coastal and offshore catches

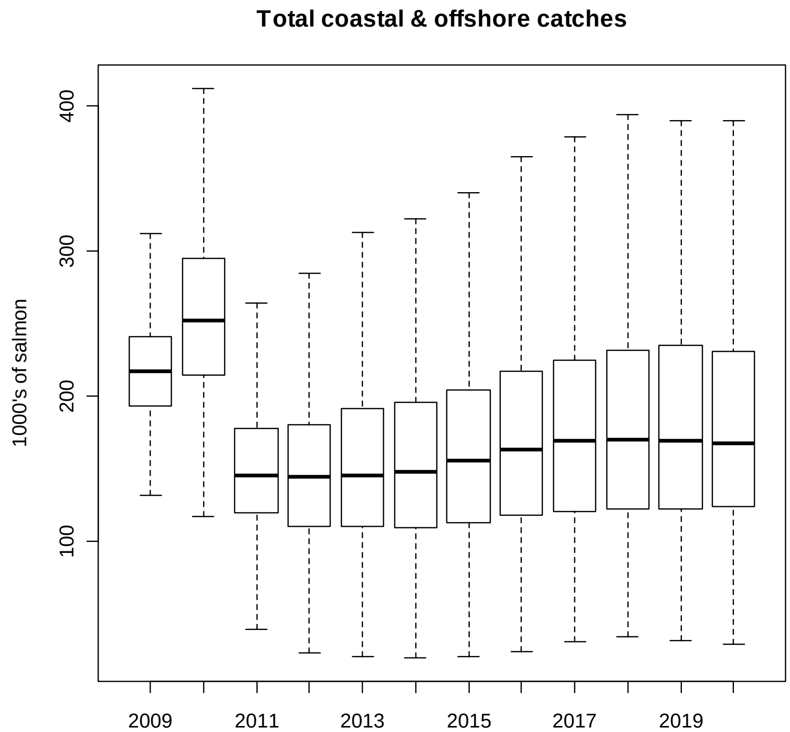
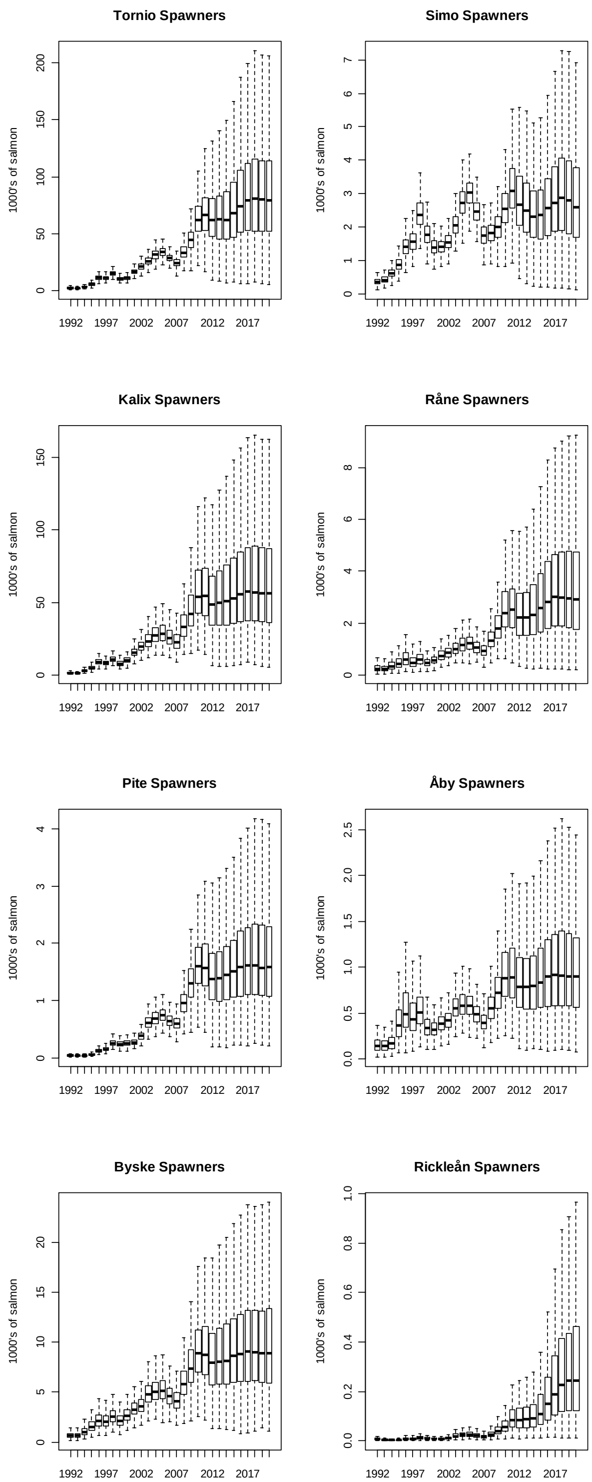


**Figure. 7. Results of simulations for the following HR scenario.**
Cumulative harvest rate for 3SW salmon is 0.1 after 2011.
Minimum coastal effort.
No river fishery for Simo, Rickleån, Öre, Mörrumsån or Emån.

Fig 7a. Development of spawning populations



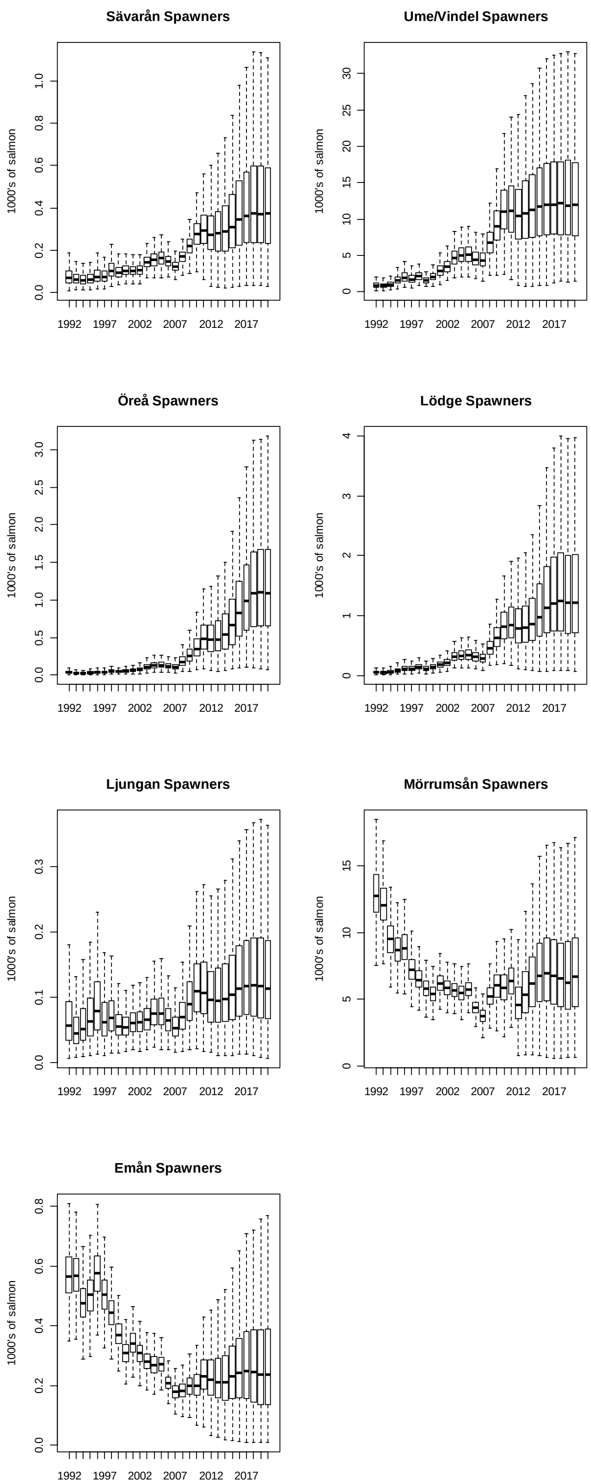

Sävarån Spawners
Ume/Vindel Spawners
Öreå Spawners
Lödge Spawners
Ljungan Spawners
Mörrumsån Spawners
Emån Spawners
1000's of salmon
1992
1997
2002
2007
2012
2017

Figure 7b. Probability of achieving a minimum of 80% of potential smolt production by assessment Unit

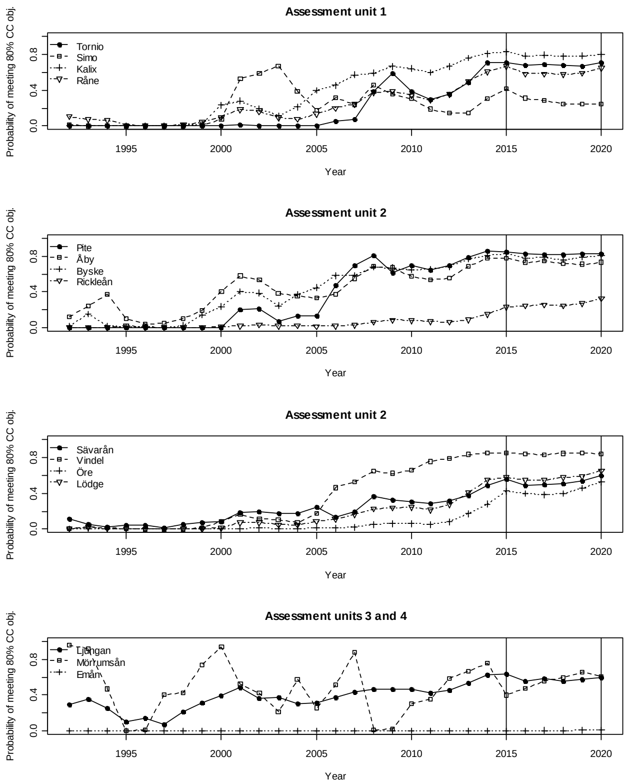



Figure 7c. . Estimated numbers of unexploited reared salmon by assessment unit

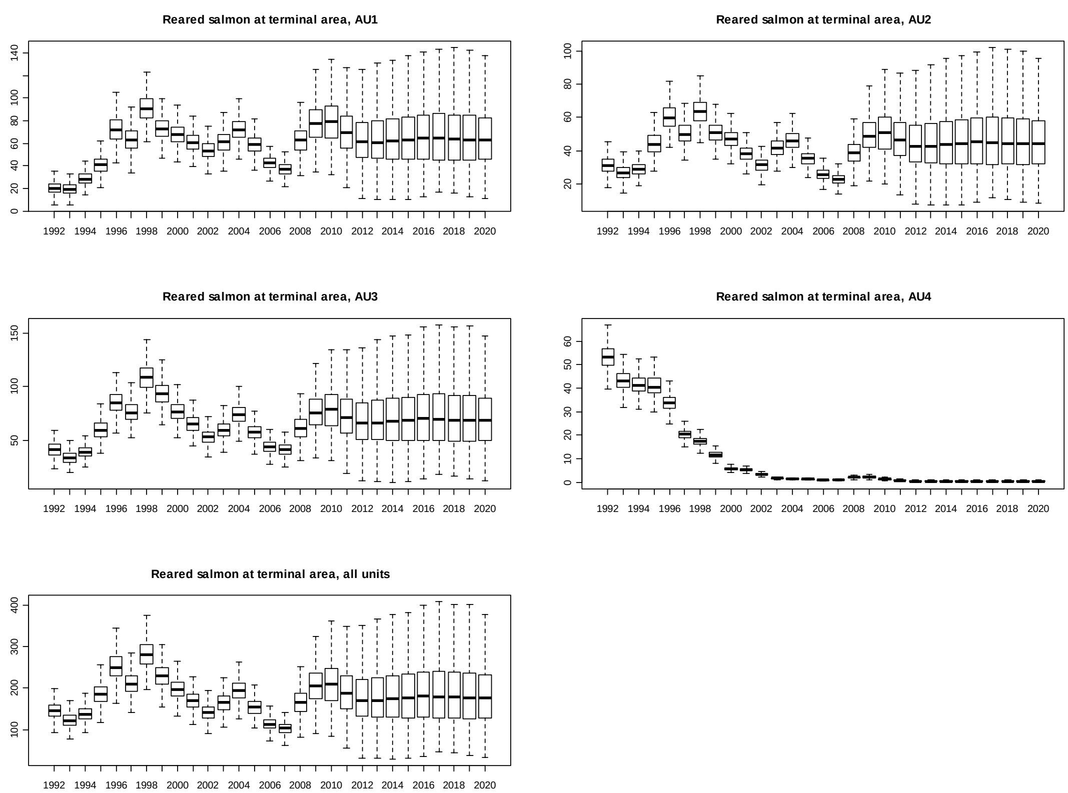
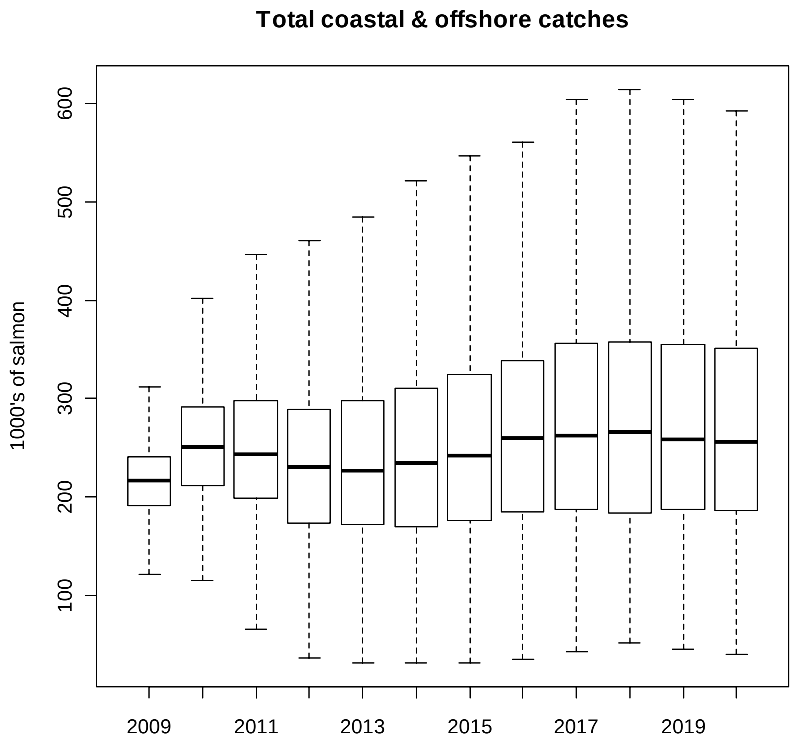


Figure 7d. Predicted coastal and offshore catches



European Commission

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**Abstract**
The Scientific, Technical and Economic Committee for Fisheries gave its opinion by written procedure in December 2009 on request by the European Commission for complementary information to the opinion delivered by the STECF plenary (STECF/PLEN-09-03) regarding harvest control rules for the long-term management of the Baltic salmon.

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